Amendments to the Specification

[0029] In the context of telecommunications, multiple transmitters and multiple receivers may be connected to a network. A transmitter generates a sequence of narrow pulses which are modulated into zero and finite pulses to represent binary data. The transmitter imposes such a code on each pulse by differentially phase modulating its wavelength components. The differentially phase modulated pulses are then input to the network and received at all the receivers. However, only the one or more receivers having the conjugate of the same code recover the narrow pulses. Receivers that have non-matching codes detect only background noise. Further, in some applications, the multiple transmitters need not be synchronized as long as they are all using different codes. Even though spread pulses of different codes may temporally overlap as they propagate around the network, the decoding extracts the narrow pulse sequence from the overlapping spread pulses.

[0030] An O-CDMA telecommunication system enabled by the invention may be based on a building block illustrated in the circuit diagram of FIG. 2, which may be used as part of either the transmitter or receiver. In a substrate 30 are formed a demultiplexer 32 and a multiplexer 34, preferably formed of arrayed waveguide gratings (AWGs). An input waveguide 36 formed in the substrate 30 receives an optical signal and conveys it to an input side of a first free-space region [[46]] 38, in which the optical signal diverges. A plurality of grating waveguides 40 are connected from the output side of the first free-space region 38 to the input side of a second free-space region 42. The lengths of the grating waveguides 40 between the two free-space regions 38, 42 differ by predetermined amounts thereby introducing differential phases to the optical signals entering the second free-space region 42 and then diverging towards the output side and there combining and constructively or destructively interfering. The interference depends upon wavelength so the system acts as a diffraction grating to spectrally separate the optical signal across the output side of the second free-space region 42. The two free-space regions 38, 42 and array gratings 40 form an AWG acting as a wavelength demultiplexer.

[0040] The fabrication of InP AWGs and active elements, such as modulators, has been described by Yoo in U.S. Patent Application, Serial No. 10/081,396, filed February 22, 2002,

now issued as U.S. Patent 6,678,827, and incorporated herein by reference in its entirety, which focuses on integrated optical routers. The entire block of FIG. 2 can be formed in one monolithic structure based on buried heterostructure waveguides for both the passive and modulator sections. As illustrated in the cross-sectional view of FIG. 4 for a passive section 78, in particular the waveguides and the free-space regions, over an n-type InP substrate 80 is grown an patterned an InGaAlP quaternary region 82 have a composition corresponding to a photo luminescent wavelength of 1.3μm. An etch stop layer 84, for example, 20nm of undoped InP is deposited over the quaternary layer 82. The laser section to be described later includes a quantum well structure. In the integrated chip, the quantum well layer is deposited over the etch stop layer 84 in all regions of the chip but is etched away in all of the non-laser regions with the etch stop layer 84 defining the end of the quantum well etch. These layers are patterned to form a ridge waveguide. For the waveguide sections, the waveguide width is chosen to provide a single-mode waveguide. For the free-space regions, the waveguide width is much wider and shaped to provide coupling between the input and output ports but it nonetheless is vertically confining. In the interest of maximizing power coupling rather than minimizing cross talk and to allow modulation channels of variable bandwidth, it is advantageous to include multi-mode interference (MMI) filters between at least some of the waveguides and the free space regions, as has been described by Bulthuis and Amersfoort in U.S. Patent 6,289,147. The waveguide is buried by the subsequent deposition of a layer of semi-insulating InP layer 88 to electrically isolate the buried waveguide. For integration purposes, a top layer 90 of n-type InP is deposited over the semi-insulating InP layer 88.